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(54) Formwerkzeug

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The invention relates to a forming tool of the type corresponding to the pre-characterizing clause of Claim 1.

Forming tools of this type are known from practice. Amongst other applications, they are used for the manufacture of so-called meal trays for ready-to-eat meals. These trays have relatively large cross-sections with several chambers designed to receive the meals and accompaniments, their edges lying in a common plane and serving the purpose of sealing the lid on. Due to the high quality required of this sealing process, wall thickness specifications are frequently set for the sealing edge. These wall thickness specifications are hard to meet with standard forming tools, particularly in the case of materials such as PP (polypropylene). The manufacture of the preform comprises an initial deep-drawing process which is followed by a blowing process designed to lay the still plastic preform created by deep-drawing against the mould wall, thus giving it its final form and cooling it (thermoforming). In the deep-drawing processes, the film is drawn again against the deep-drawn edges of the moulds with a specific pressure course of the holding-down device. Forming tools of the type under discussion here have several mould nests, for example six mould nests in a regular rectangular arrangement for the simultaneous manufacture of six meal trays. The surface affected by the deep-drawing process is therefore relatively large and it is not always easy to meet the wall thickness specifications at the sealing edge in all cases with the desired uniformity.

The object of the invention is to improve the quality of the preforms manufactured, particularly in respect of wall thickness specifications.

This object is achieved by the invention described in Claim 1.

The lattice bars of the clamping frame surround each individual mould nest and the section of plastic film allocated to the individual mould is therefore stretched evenly around the mould and its associated holding-down device once again. This means that the stress ratios at the deep-drawn edge of each mould are more even and can be better defined and the repeated drawing stress occurring in one mould is isolated from the neighbouring mould.

According to Fig. 2, the lattice forming the clamping frame is usefully a rectangular lattice, one mould being positioned in each lattice hole.

A feature which is important for the even effectiveness of the clamping frame across the entire working surface of the forming tool is the subject of Claim 3. This feature enables the clamping frame to adapt to any minor variations in its contact surface.

In the preferred embodiment, the clamping frame is pressed against the other delimiting surface by means of a fluid pressure medium (Claim 4), in particular in the manner described in Claim 5, by means of piston/cylinder units positioned at the corners of the lattice which supply the pressing force for the lattice.

The clamping bars which form the lattice bars are usefully strip-shaped, i.e. made of bars with a flat rectangular cross-section positioned on edge (Claim 6), which are advantageously notched at the intersection points as described in Claim 7 in such a manner that the clamping bars pass through several mould nests in one piece and are still able to intersect with the lattice at the same height. The notches simultaneously provide a certain additional flexibility of the lattice in its plane.

The piston/cylinder units are usefully designed as described in Claim 8.

Claim 9 deals with an important development. During the deep-drawing process the clamping bars, which should be designed as relatively thin strips, experience quite considerable transverse tensile forces which might cause them to warp unless special measures were taken. This would partially negate the purpose of the clamping bars, namely to even out the material as it is drawn in. The grooves in the delimiting surface, positioned in accordance with the rectangular or other pattern of the lattice, act against the transverse forces.

The drawing shows an embodiment of the invention.

Fig. 1 shows a side view of a forming tool as disclosed in the invention, in a partial vertical section.

Fig. 1a shows a vertical section through the holding- down device illustrated in Fig. 1.

Fig. 1b shows a view of the holding-down device from below.

Fig. 2 shows a top view of the blanking punch plate which can be seen in Fig. 1.

Fig. 3 shows a section along the line marked III-III in Fig. 2.

Fig. 4 shows a section along the line marked IV-IV in Fig. 2.

Fig. 5 shows a view of an individual clamping strip.

Fig. 6 shows a view of an individual clamping strip running at right angles thereto.

Fig. 7 shows a view of the end area indicated by a chain-dot line in Fig. 5 in a larger scale.

Fig. 8 shows a view in accordance with Fig. 7 from the left.

Fig. 9 shows a view of an individual piston positioned in the corners of the lattice.

Fig. 10 shows a view in accordance with Fig. 9 from above.

Where a description of the entire tool designated by the reference numeral (100) refers to a "lower part" (10) of the mould (lower tool) and an "upper part" (20) of the mould (upper tool) in accordance with the embodiment illustrated in which the pre-stretcher (or stretching aid) (25) moves from the upper part (20) positioned at the top down into the lower part (10) of the mould. This arrangement can also, of course, be reversed with the pre-stretcher (25) moving from bottom to top. Similarly, the cutting plane (S) which delimits the bottom of the upper part (20) of the mould and contains a group of cutting edges which separate the preform from the film belt (26) after forming, does not have to be horizontal as in the embodiment.

Positioned on a horizontal carrier plate (1) located on a tool base are vertical guide columns (2) on which the upper part (20) of the mould is mounted in such a manner that it can be moved vertically. Positioned on the carrier plate (1) between the columns (2) is a

blanking punch plate (3) which has a multiplicity of cylindrical recesses (4) which form the mould nests (F), the number of which corresponds to the number of preforms, e.g. plastic cups, which the forming tool (100) can manufacture simultaneously.

Positioned in each of the recesses (4) is a cooling liner (5) which forms a coolant channel (7) which runs around the outer periphery. Sitting in the cooling liner (5) is a mould insert (8), indicated in Fig. 1 by means of a chain-dot line, the internal shape (9) of which forms the outside of the preform to be manufactured, e.g. the meal tray described in the embodiment. Together the cooling liner (5) and the mould insert (8) form the mould positioned in the relevant mould nest (F). Access to an ejector (not illustrated) which lifts the finished preform out of the mould insert (8) is provided through an opening (11) in the base of the cooling liner (5). At the upper end, the cooling liner (5) has a front face (12) which protrudes a little above the upper side (3') of the blanking punch plate (3) and forms a sharp cutting edge (13) at its outer edge.

The upper part (20) of the mould comprises a holding-down plate arrangement (21) which consists in the embodiment of the actual holding-down plate (22) and a cutting plate (23) located below it, the lower delimitation of which forms the cutting plane (S). The holding-down plate (22) and the cutting plate (23) have recesses (24, 27) which are coaxial to the axis (A) of the recess (4) in the blanking punch plate (3) and in which the holding-down device (30) can be moved in the direction of axis (A).

The holding-down devices (30) have recesses (34, 35, 36) which are open at the bottom, two of them (35 and 36) being visible in Fig. 1a. They have cylindrical external surfaces (30') which slide along the recesses (24, 27) in the holding-down plate (22) and the blanking punch plate (23).The lower edge of each holding-down device (30) facing the film belt (26) bears a thrust collar (37) with a cross-sectional shape which can be seen from Fig. 1b. The thrust collar (37) is cooled by a coolant channel (37') formed at the edge of the holding-down device (30) and has a flat lower front face (32) which co-operates with the upper front face (12) at the mould nests (F) to clamp the film belt (26) into place during the deep-drawing process.

All the holding-down devices (30) are positioned with their open sides facing downwards and with their bases (30'') fixed to a plate-shaped holding-down bridge (28)

which is positioned above the holding-down plate (22) and is exposed to a downward pneumatic force which is adjustable in its strength and its timing and is also under the influence of downward pressing helical springs (29) which are supported on a top plate (31) which is rigidly connected to the holding-down plate (22) and guided by the columns (2). Thus all the holding-down devices (30) automatically move together and have exactly the same stroke.

In the embodiment, the preform is a meal tray with three chambers or compartments (14, 15, 16) (Fig. 1b) which correspond to the recesses (34, 35, 36). In the corresponding recesses (34, 35, 36) in the holding-down device (30) is positioned a pre-stretcher (25) which is designed as a forming unit with three slightly conical, downward tapering forming bodies, the external form of which corresponds largely to the internal form of the three chambers (14, 15, 16) in the meal trays and which can be moved vertically from the retracted position in the holding-down device (30) indicated in Fig. 1 downwards into the mould insert (8) by an amount corresponding approximately to the depth of the preform, the mould insert (8) containing three forming cavities which correspond to the three chambers (14, 15, 16).

The forming tool (100) serves for the manufacture of preforms by means of a forming process known as thermoforming which is a deep-drawing process with pneumatic post-forming, i.e. followed by a blowing process. By appropriate means (not illustrated) a film belt (26) made of plastic heated to its plastic temperature range is pushed gradually between the lower (10) and the upper part (20) of the mould. When the film belt (26) is stationary, the lower (10) and upper (20) parts of the mould move closer together, thus clamping the film belt (26) between the upper front face (12) of the cooling insert and/or the mould insert (8) and the lower front face (32) of the corresponding holding-down device (30). The pre-stretcher (25) moves down and during this stroke draws the material in the clamping area down into the mould insert (8). The force prevailing between the two front faces (12, 32) must be controlled with great accuracy in order to ensure that the preform yields correctly at the edges and the thickness of the edge corresponds to the desired amount. After the deep-drawing stroke of the pre-stretcher (25), air is blown in through the feed line (35) and lays the still slack pre-formed wall of the preform around the inner periphery (9) of the mould insert (8). The lower (10) and upper (20) parts of the tool are then once again brought closer together, the front face (12) pressing the holding-down device (30) to be pressed upwards and back against each mould nest (F), the annular cutting edge (13) formed at its outer edge co-

operating with the corresponding annular cutting edge (33) formed on the blanking punch plate (23) and the preform separating from the remaining lattice of the film belt (26) around its outer edge. Once the lower (10) and upper (20) parts of the mould have moved apart, the totality of edged preforms manufactured are then lifted out of their respective mould inserts (8) by means of an ejector (not illustrated) and removed by moving the lattice of the film belt (26) further out of the forming tool (100). The film belt (26) then stops and the cycle begins again.

The forming tool in the embodiment illustrated is a forming tool with six mould nests (F) arranged in a rectangle as shown in Fig. 2. In order to even out and better control the intake of material during the deep-drawing process, a clamping frame referred to in its entirety by means of the reference numeral (40) is designed as a rectangular frame with quadratic lattice openings and three clamping bars (41) which run longitudinally along the length of the working surface of the forming tool (100) and four clamping bars (42) which run vertical thereto (Figs. 1, 5, 6). At the intersection points of the lattice bars (41 , 42) are provided piston/cylinder units (50), the cylinders of which are mounted in the blanking punch plate (3).The pistons (54) extend beyond the upper delimiting surface (3') of the blanking punch plate (3) by approximately half the height of the clamping strips. The pistons (54) are dual-action and can be extended upwards out of the delimiting surface (3) pneumatically or retracted pneumatically.

As illustrated in Figs. 5, 6 and 8, the clamping bars (41, 42) are strip-shaped sections of flat rectangular cross-section made of steel which are positioned on edge. The clamping bars numbered (42) run transversely and bridge only two mould nests, while the clamping bars numbered (41) run longitudinally, bridge three mould nests and are therefore commensurately longer.

The clamping rods numbered (42) have grooves (44) cut into them from above as far as half the height of the clamping rod (42) at the intersection points with the clamping rods numbered (41), the width of which corresponds to the thickness of the clamping rods (41). The clamping rods numbered (41) which have the same cross-section have grooves (43) at the intersection points which are open downwards which are the same width as the clamping rods numbered (42) and half the height of the clamping bars numbered (41). Thus, the clamping bars (41, 42) can be joined to form a lattice which is the same height everywhere.

The ends of the clamping bars (41, 42) on the side facing the plastic film (26) are provided with sloping faces (45).

Fig. 2, which shows the upper delimitation surface (3') of the blanking punch plate (3), illustrates not the clamping bars (41, 42) but the grooves (51, 52) provided to receive them which form a rectangular arrangement, are as wide as the clamping bars (41, 42) and are as deep as half the height of the clamping bars (41, 42). At the intersection points of the grooves (51, 52) are provided the cylinders (53) for the piston/cylinder units (50).

In the operational condition illustrated in Fig. 1, the pistons (54) which are shaped as shown in Fig. 9 are placed in the cylinders (53). The pistons (54) have a peripheral groove (55) to take a seal and their heads (56) project approximately half their length beyond the delimiting surface (3'). The heads (56) have cruciform grooves (57, 58) to receive the intersection points of the lattice formed by the clamping bars (41, 42). Threaded holes (59) running at right angles to grooves (57, 58) are provided to take fixing screws, the leading ends of which engage in transverse holes (46) tight against the notches (43, 44).

The piston/cylinder units (50) are all connected to the same pneumatic pressure. If the lower (10) and upper (20) parts of the mould are moved into the working position, pressure is supplied to the twelve piston/cylinder units (50) which press the clamping bars (41, 42) or the lattice which they form with forces which are evenly distributed across the working surface of the forming tool (100) against the plastic film (26) which is itself supported on the cutting plate (5) of the cutting plate (23). The pre-stretchers (25) are then lowered to approximately preform depth. After a slight delay, the lower (10) part of the mould is then moved towards the upper (20) part of the mould until the holding-down device (30) and the upper front face (12) of the cooling liner (5) clamp the film in place. During this process, the clamping frame (40) is pressed further towards its end position. As the pre-stretchers (25) move downwards into the mould nests (F), plastic film (26) from the vicinity of the nests is also drawn in for the forming of the preform. The wall thickness of the preform is thereby increased, making the preform more stable.

The use of the clamping frame (40) eliminates the need for a stripping plate and stripping bolts.

Claims

1. Forming tool (100) for the manufacture of preforms, in particular meal trays for ready-to-cook meals, etc., by the deep-drawing of heated thermoplastic plastic film (26),

with a lower part (10) of a mould with at least one mould nest (F) to receive a mould (8) for the outer shape of the preform,

with an upper part (20) of a mould which can be moved along an axis (A) towards the lower part (10) of a mould with a holding-down plate arrangement (21) on the side facing the lower (10) part of the mould delimited by a cutting plane (S) vertical to the axis (A) with a recess (4) which fits flush with the mould nest,

with means of gradually pushing the heated plastic film (26) between the lower part (10) of the mould and the upper part (20) of the mould,

with one bushing- or barrel-shaped holding-down device (30) positioned in the recess (24, 27) in the holding-down plate arrangement (21) for each mould nest (F), the front face (32) of this holding-down device (30) facing the lower part (10) of the mould lying opposite a front face (12) on the upper edge of the mould facing the upper part (20) of the mould and it being possible to push it back against a flexible force in the direction of axis (A), thereby clamping the plastic film (26) in position, when the lower part (12) of the mould is moved closer to the upper part (20) of the mould,

with a pre-stretcher (25) which largely matches the inner shape of the preform which is positioned in the holding-down device (30) at the start of a deep-drawing stroke and can be advanced out of the holding-down device (30) into the mould (8) by an amount corresponding essentially to the depth of the preform during the deep-drawing stroke,

and with a cutting edge (13) formed on the upper mould edge of the outer edge on the front face (12) which co-operates with a cutting edge (33) in the upper part (20) of the mould located in the cutting plane (S),

characterized in that

positioned in one of the facing delimiting surfaces (3'/S) of the lower part (10) of the mould or the upper part (20) of the mould is an essentially flat lattice-shaped clamping frame (40) which can be pressed against the other delimiting surface flexibly, the mould nests located in its lattice openings of which the mould nests and the clamping bars (41, 42) forming it lattice bars surrounding the mould nests (F).

2. Forming tool in accordance with Claim 1, **characterized in that** the lattice forming the clamping frame (40) is a rectangular lattice.

3. Forming tool in accordance with Claim 1 or 2, **characterized in that** the clamping frame (40) is flexible in its plane.

4. Forming tool in accordance with one of Claims 1 to 3, **characterized in that** the clamping frame (40) can be pressed against another delimiting surface by means of a liquid pressure medium.

5. Forming tool in accordance with Claim 4, **characterized in that** positioned in the corners of the clamping frame (40) acting parallel to the direction of the axis (A) are piston/cylinder units (50) which can be actuated by means of the fluid pressure medium and by means of which the clamping bars (41, 42) forming the clamping frame (40) can be moved at right angles to each other towards the other delimiting surface.

6. Forming tool in accordance with one of Claims 1 to 5, **characterized in that** clamping bars (41, 42) are formed by bar sections of flat rectangular cross-section positioned on edge.

7. Forming tool in accordance with Claim 6, **characterized in that** at the intersection points the clamping bars (41, 42) have notches (43, 44) half their height and that the clamping bars (42) running in one direction along the clamping frame (40) have the notches (44) on the top and the clamping bars (41) running in the other direction have the notches (43) on the bottom and the clamping bars (41, 42) running in both directions interlock at the notches (43, 44).

8. Forming tool in accordance with one of Claims 5 to 7, **characterized in that** the cylinders (53) in the piston/cylinder units (50) are designed in the respective part (10/20) of the mould and the pistons (54) project beyond the delimiting surfaces (3', S) and have crosswise grooves (57, 58) in their end areas to receive the clamping bars (41, 42).

9. Forming tool in accordance with one of Claims 1 to 8, **characterized in that** grooves (51, 52) forming a rectangular pattern are provided in the delimiting surface (3') to receive and transversely guide the clamping bars (41, 42).

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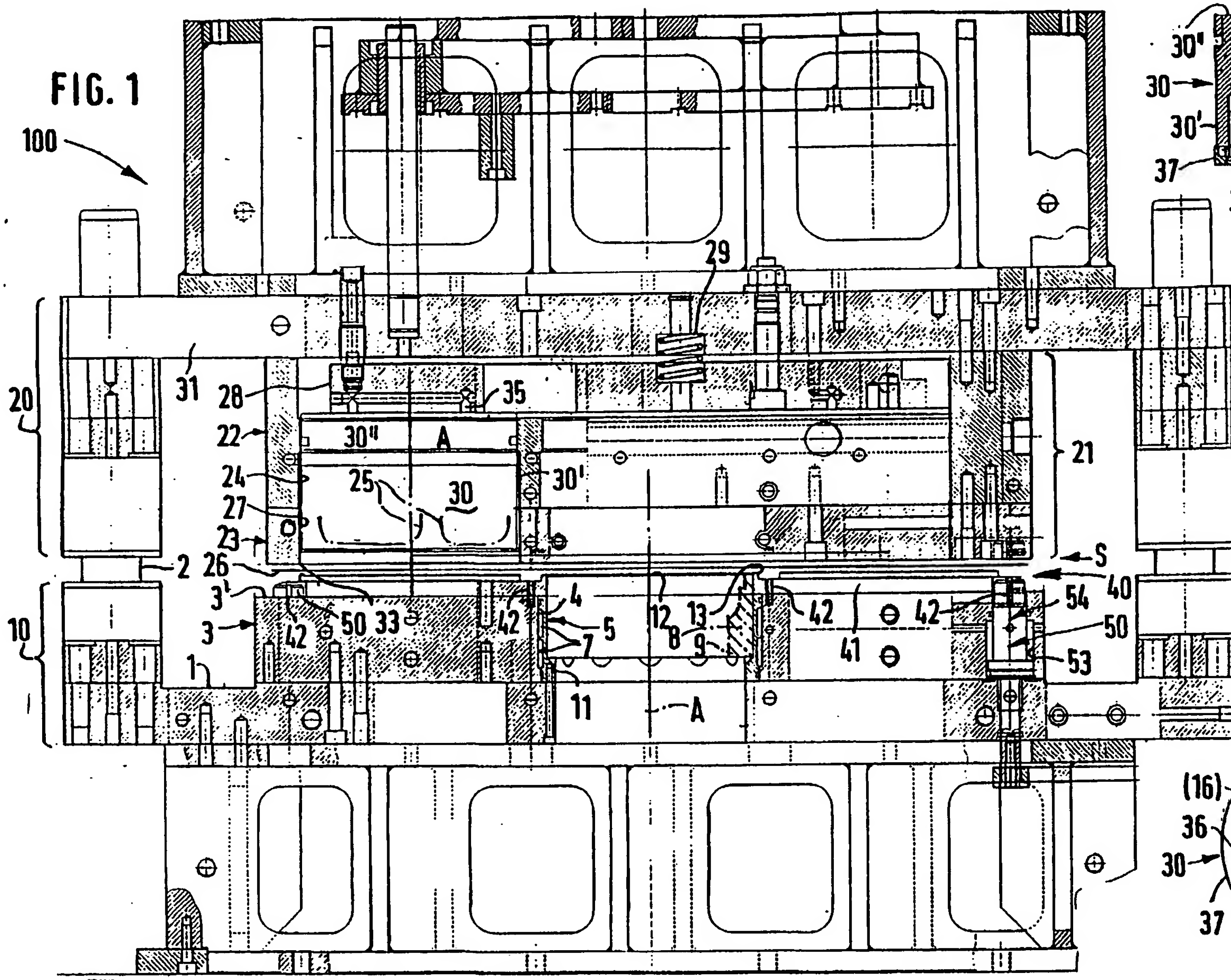
FIG. 1



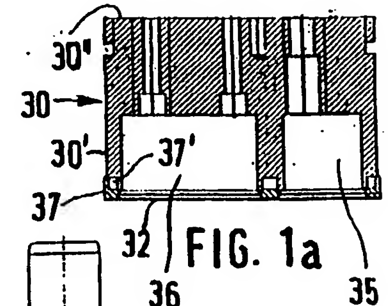
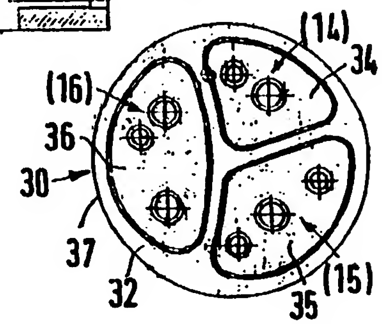


FIG. 1a

FIG.1b



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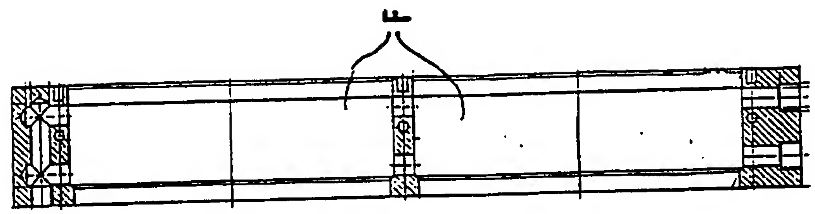

FIG.4

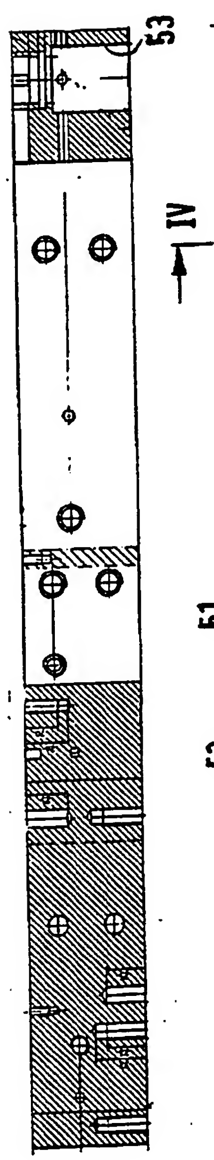

FIG.3

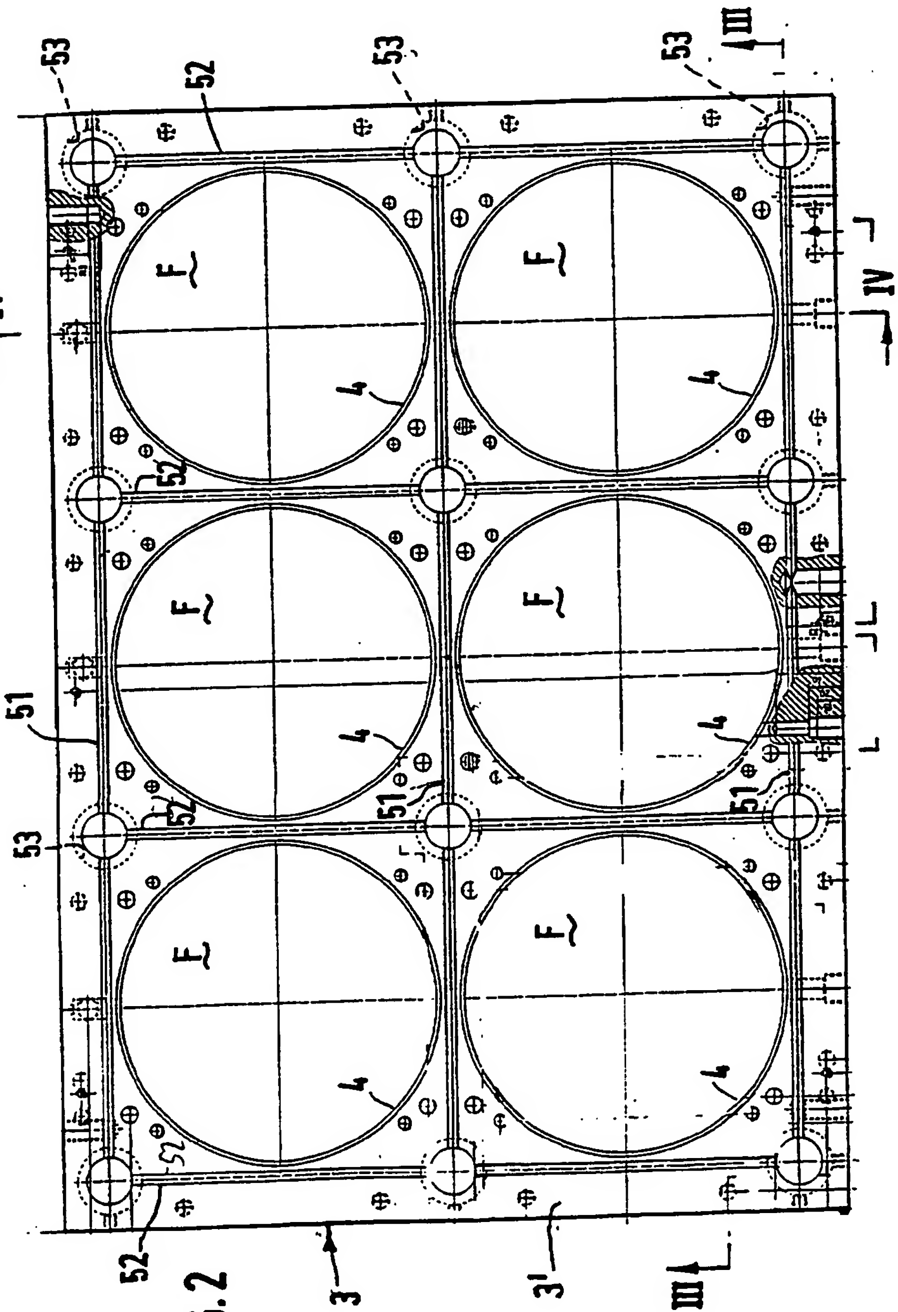

FIG.2

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FIG. 5

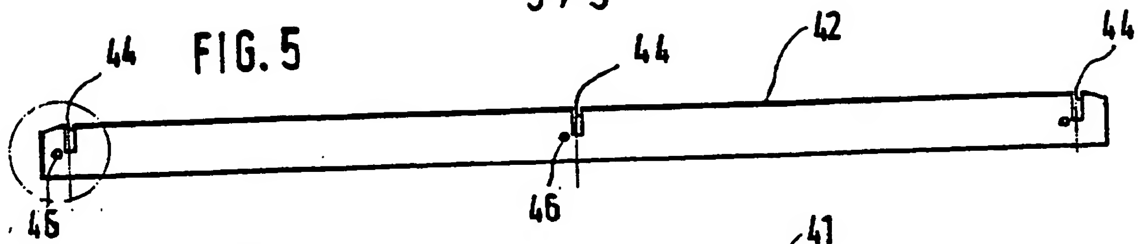

FIG. 6

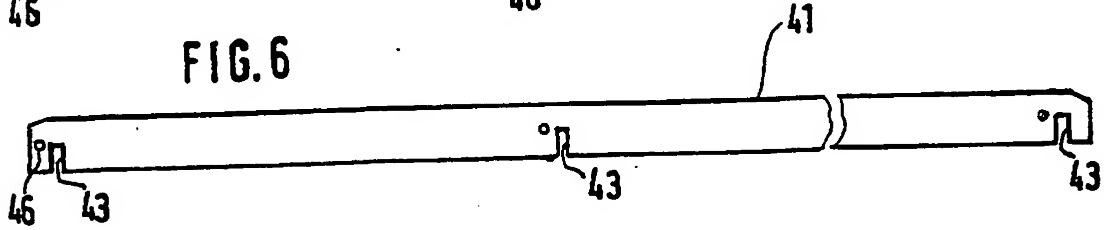

FIG. 7

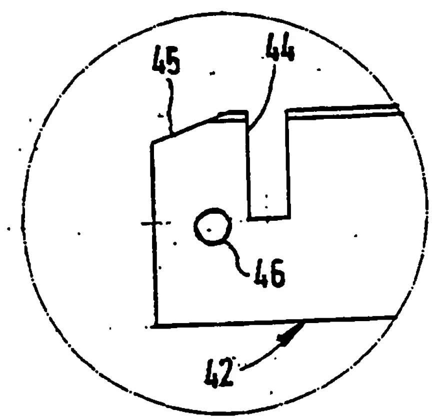

FIG. 8

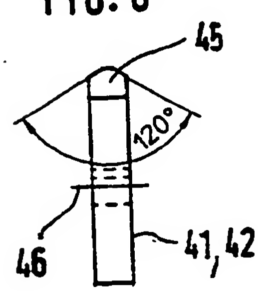

FIG. 9

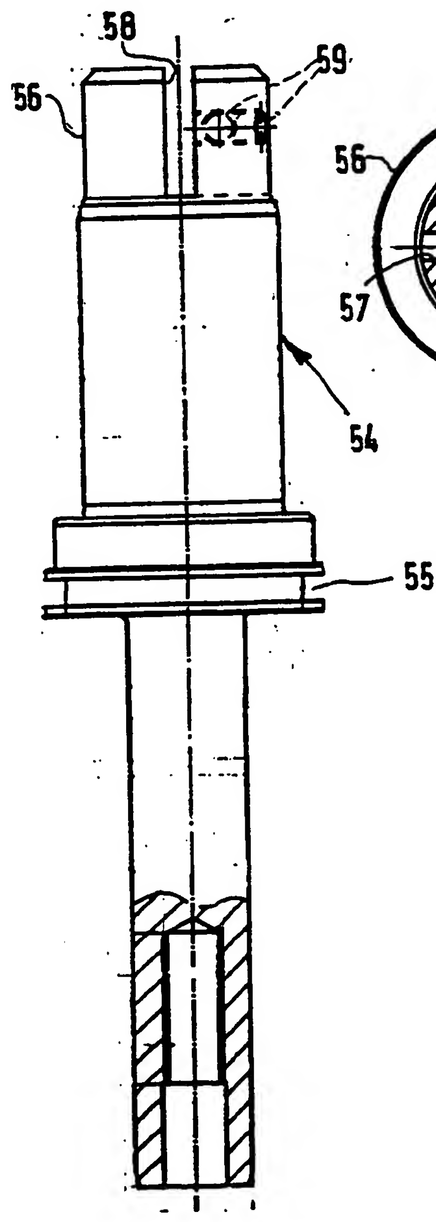

FIG. 10